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SOME OBSERVATIONS ON THE USE OF THE
HYDROCHLORATE OF COCAINE,

ESPECIALLY ITS HYPODERMIC USE.

By

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HYDROCHLORATE of cocaine is a drug evidently of such power that, on reading the effects produced on the eye, I determined to investigate its properties in other respects, with a view of ascertaining whether it might be of use to the physician as well as to the ophthalmologist. I shall first detail some conclusions I have arrived at with reference to its *local* action.

On the *throat* it undoubtedly diminishes the sensibility, and is serviceable in causing the laryngoscope to be better borne. Moreover, it is of use in irritable relaxed throats, and in instances in which there is spasmodic difficulty in swallowing associated with this irritability, or from other causes. In ulcers at the back of the throat, connected with dysphagia, painting the parts two or three times daily affords considerable relief. Only for this to last, the solutions employed must be stronger than those which have been used—not from two to four, but from eight to

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twelve per cent. In tubercular laryngitis the action is excellent. Even a four per cent. solution gives hours of relief, in some cases as many as six hours' freedom from the sense of irritation and the difficulty of swallowing; and stronger solutions relieve for a longer time. The result obtained is far more certain and decided than from the local use of morphia. Compared with iodoform, it is probably less permanent, but as good, or better, at the time.

Dr. Jurist, whom I asked to employ the hydrochlorate of cocaine at the throat clinic of the Jefferson Medical College, has favored me with a note, in which he speaks of the remedy being "brilliantly successful" in relieving pain and making deglutition easy in painful diseases of the pharynx and larynx, pre-eminently in tuberculosis and in syphilis.

Using chromic acid and the galvano-cautery frequently, he found that, by first painting the parts with a four per cent. solution, the employment of these agents could be made comparatively painless, and that the efficacy of these, or indeed of all caustic and destructive means, is not interfered with.

In syphilitic ulcerations especially this was tested, and much suffering prevented. Where only four per cent. solutions are employed, the patient may not feel the caustic application to the abraded surface for about twenty to thirty minutes, but after this it becomes painful. All trials should be preceded by careful cleansing of the parts. The local action of the cocaine is also astringent and hemostatic as well as one destroying sensibility. This local action may also be perceived on tongue and gums. "Although facilitating intra-laryngeal medication, it does not prevent

spasms," Dr. Jurist writes me, "and consequently is valuable in intra-laryngeal operations only on account of its anæsthetic effects.

As regards the local use of cocaine on other portions of the body, I am able to record some observations made in my ward at the Pennsylvania Hospital. In one instance pain in a hollow molar tooth was speedily relieved by inserting a piece of cotton saturated with a four per cent. solution. It may in passing be remarked that cocaine used hypodermically in the same patient failed to mitigate an attack of intestinal pain of colicky kind which had lasted for two days. A case of earache, which seemed to be neuralgic, was at once relieved by instilling a few drops of a four per cent. solution into the meatus; and a similar observation was made by the resident physician in the ward of my colleague, Dr. Hutchinson. As regards facial neuralgias, the results were less decisive than anticipated. Perhaps they would become more so if we were to rub in an oleate of cocaine over the aching nerves, or larger nerve trunks; or to use a hypodermic for its local use where the disordered nerves are superficial and easily reached. In one instance of neuralgia of the face in which the pain shot into the jaws, painting the gums of the upper jaw with a four per cent. solution gave very speedy relief. For the amelioration of painful and irritable affections of the nasal mucous membrane, hydrochlorate of cocaine, in not less than a four per cent. solution, is of use; and I have known applications with caustics made without pain when the membrane, after being well cleansed, had been painted with the solution. Since becoming acquainted with the action of the remedy, I have had no case of

rose cold or hay fever. But it ought to be of service, and I would suggest its employment in these most troublesome affections.

While discussing its local use it may not be inappropriate to refer to the fact that the solutions of the hydrochlorate of cocaine we all employ—Merck's hydrochlorate—contain less of the alkaloid than supposed; a four per cent. solution, for instance, is only of about three per cent. strength. My attention was called to this by Dr. Jurist, whose remarks, speaking of his observations, I append; and while writing these lines I find that Dr. Squibb has just published the same conclusion:—

“The difficulty experienced in obtaining the cocaine hydrochlorate in bulk, while the solutions were always at command, made it seem desirable to study the latter more closely. In conjunction with my friend, Mr. Stedem, a number of examinations were made. Our later investigations included Merck's manufacture in bulk.

“*Experiment I.*—On adding a dilute solution of ammonia to a solution of the cocaine salt, and then agitating with chloroform, the ammonium hydrochlorate could readily be drawn off with a pipette, leaving the cocaine in solution in the chloroform. By carefully evaporating both solutions the ammonium salt was readily obtained in pure crystalline form. On the watch-crystal into which the chloroform solution was poured there was formed a number of *white acicular crystals surrounded by an areola of sticky resinous material*, light-yellow in color, and altogether amorphous in character. The crystals were soluble in hot and cold water; the resinous product in dilute *hydrochloric acid*, but not in water.

“*Experiment II.*—Another portion of the solution was carefully evaporated over a water-bath. The resulting mass was similar in appearance to the first, but was readily soluble in water. The difference in solubility is accounted for by the

acid state of the residue. When it is remembered that cocaine and its salts have heretofore been described as colorless and crystallizable, and that Merck's product is amorphous granular, and of a light straw color, and further, that chemical manipulation separates a resinous mass from the commercial article, the proposition that our present solutions do not contain the full proportion of the active principle appears to be well grounded."

But what has interested me much about the drug, and what, as far as I know, has not been as yet investigated, is its hypodermic employ, elucidating its general action. In the observations I am about to detail, I have been greatly aided by Dr. Ecroyd, the resident physician in my ward at the Pennsylvania Hospital, and by Dr. Woodbury. We have tried the remedy both on the well and the sick, especially in cases of neuralgia and other painful affections, and have arrived at certain definite conclusions. But first let me speak of the dose. We began with one minim of a two, then of a four per cent. solution, only to find them inert. No influence could be detected on pulse, respiration, or temperature; nor was any local anæsthesia produced at the point of injection. Indeed, no decided effects are produced with less than eight minims of a four per cent. solution, or one-third of a grain of the hydrochlorate of cocaine; and half a grain will show these effects even more strikingly. In some instances two-thirds of a grain were used.

As regards the local influence at the point of injection, there is considerable difference whether a superficial or a deep hypodermic be used. A hypodermic thrown into the superficial layers occasions local anæsthesia, so that the part may be pricked with needles without

these being felt. In one case in which we tried one of these superficial injections in a boy of nineteen, a wheel was produced which was quite insensitive, while all around it sensation was preserved, though perhaps slightly reduced. It is evident, therefore, that if it be desirable to use the hypodermic means of producing local insensibility for the removal of small tumors and the like, a superficial injection immediately into or very close to the parts to be removed will have to be practised. These superficial injections do not occasion subsequent inflammation or abscesses. This is equally true of deeper injections into the tissue below the skin; in the manner in which hypodermics are generally given. But the deeper injections do not produce local anæsthesia of the surface.

Now, as regards the *general* effect of hydrochlorate of cocaine hypodermically employed, it has a little, but not very much, influence on *sensation*. Most patients speak of a sense of warmth all over the body, which, beginning at the point of injection, becomes general in from five to ten minutes; it is, however, not of long duration, the arm in which the injection is practised feeling numb or heavy, or, as one expressed it, "funny." In him, half a grain having been thrown into the left forearm, the sensibility of the skin was diminished from the elbow down to the fingers on that side, and two sharp points were not as distinctly as previously distinguished at the tips of the fingers. There was no change of general sensibility in the legs. The mucous membrane of the lips, tongue, and fauces was slightly less sensitive to sharp points; the conjunctiva was less sensitive, the pupils were dilated.

On the whole, then, there is some general reduction of sensibility, though it is not marked, and is transitory. And this observation accords with others in which one-third of a grain was used, where the alteration of sensibility showed even less; and with a few in which two-thirds of a grain were employed. The general sensibility is therefore only slightly altered.

On the *temperature*, the effect is to heighten it somewhat. This is the record taken by Dr. Ecroyd in the case of a well-nourished man suffering from pains in the back and gluteal region, seemingly due to muscular rheumatism:—

One-third of a grain of hydrochlorate of cocaine was used; no local anæsthesia was produced at the point of injection, and there was no influence on the pain.

At 11 A. M. (just before injection), pulse 76; resp. 17; temp. 97.5°.

At 11.25 A. M. (after injection), pulse 70; resp. 16; temp. 98.5°.

At 11.40 A. M. (after injection), pulse 66; resp. 16; temp. 98.5°.

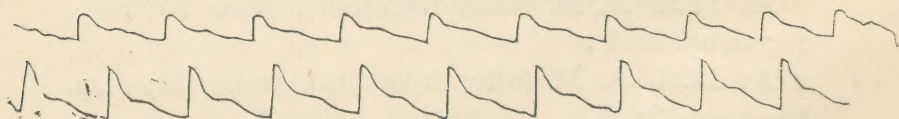
At 11.55 A. M. (after injection), pulse 64; resp. 17; temp. 98.4°.

At 12.10 P. M. (after injection), pulse 68; resp. 16; temp. 99°.

Similar observations were made in other cases; and it may, in general terms, be stated that the temperature rises from half a degree to a degree and a half; that it does not do so abruptly; but that the rise is maintained for several hours. Within ten minutes after the injection has been given, an increased heat is registered. In one case it was four-tenths of a

degree above the figure of starting, and it never reached more than half a degree, which it did one hour and five minutes after the hypodermic injection of one-third of a grain.

The most striking effect of the hypodermic injection of cocaine is on the *circulation*. The pulse may be somewhat accelerated or be slower; but it always becomes fuller and stronger. The frequency of beat was noted to fall from 66 to 54, twenty minutes after the injection. In other instances, there was but little variation; in a few, a slight quickening was detected. But in no instance was there not a fuller and a stronger pulse. We made many observations on these points at intervals of fifteen minutes, the sphygmograph being kept in place to insure uniformity of pressure, and always with the same result. I select from numerous tracings this one,



taken in a case in which half a grain of the hydrochlorate had been given hypodermically; the upper line is the pulse-trace before the injection, the lower fifteen minutes after. The higher vertical line of ascent, the more pointed summit, show the increased force of cardiac contraction; the more sudden fall in the line of descent, and the well-marked dicrotic wave, indicate no increased, rather lessened, arterial tension. And all our observations tend in the same direction. Tracings taken an hour after the

injection still show these characteristics: but the effect gradually passes away. While marked, there is decided increase of the heart's action; the apex beat is more distinct and forcible.

On the *pupils* the influence is very marked. They become speedily dilated; and with the change, uncertainty of vision is complained of. The dilatation of the pupils, following the hypodermic injection, does not last more than a couple of hours, but during this period ophthalmoscopic examination is of course very easy.

On the *secretions*, I have not as yet fully studied the drug. On the bowels it had no influence; the urine appeared increased in quantity, and the specific gravity decidedly lowered, while the phosphates were found to be increased. But our observations were not very numerous or definite on these points.

Summing up now some of the general effects observed, the drug, used hypodermically in the doses mentioned, failed to relieve attacks of intestinal pain, and was useless in instances of obstinate neuralgias, especially in sciatica. This was especially shown in a case at the Pennsylvania Hospital, in which about ten hypodermic injections were given, varying between one-third and half a grain, but in which no decided effect on the pain or the disease was produced. It is, however, fair to state that the case was of a year's standing, and had resisted blisters and chloroform injections. The cocaine influenced somewhat the dull pain; but did no permanent good. Neither in this case nor in others did it induce sleep. In certain very superficial neuralgias, its local action, not its constitutional influence, does

temporary good. As an anæsthetic, its local action is the one which will give it its greatest value; and in diseases of the eye, ear, throat, tongue, nose, and rectum, the insensibility it gives rise to suggests a wide range of application. But this insensibility cannot be produced to a sufficient degree through the constitutional effect of a hypodermic.

Yet thus resorted to, the remedy has other and valuable uses. The effects on the pulse and temperature recorded in these observations, suggest its application in many a condition of collapse, of weak heart, or heart failure; and its employ in low fevers, too, as a cardiac stimulant is a self-evident proposition. How permanent the benefit, how often the doses must be repeated, are matters which experience alone can determine.

